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Investigation of *Aspergillus* Contamination in a New Brunswick Hospital

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New Nouveau Brunswick

Investigation of *Aspergillus* Contamination in a New Brunswick Hospital

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INTRODUCTION

On May 14th, 2002 the Provincial Epidemiologist was informed by an Infectious Disease Specialist at the Saint John Regional Hospital of a number of excised heart valves that grew *Aspergillus*. Epidemiological assistance was requested to investigate the source of the contamination. In turn, the Provincial Epidemiologist requested help from Health Canada's Field Epidemiology Training Program. On May 24th, 2002 a field epidemiologist with Health Canada joined the investigative team. Consultants outside New Brunswick who have had experience in hospital outbreaks of Aspergillosis also contributed their expertise to the investigation.

BACKGROUND

The Saint John Regional Hospital (SJRH) is a teaching hospital in Saint John, New Brunswick. It has about 600 beds with a microbiology laboratory onsite. The hospital has 13 operating rooms (ORs). Adult heart operations are performed in OR #14 and #15. About 70% of these operations are bypass surgeries, the remainder involves valvular replacement operations.

Between September 2001 and May 2002, six patients had *Aspergillus* cultured from their excised heart valves. Of these six patients, two were operated on in September and November 2001, and four were operated on between April 22nd and April 30th, 2002. The April cluster results were reported to the Infection Control Coordinator on May 7th, 2002. Hospital management, Maintenance and Engineering, Risk Management and the Chief of Staff and Head of Cardiac Surgery were informed about the situation on May 7th, 2002. Hospital officials began an investigation to determine the source of the contamination of these specimens with *Aspergillus*, bearing in mind the possibility of prosthetic valve endocarditis in light of the observed cluster of positive specimens in a short period of time.

On May 9th, 2002, all ORs were closed except for emergency operations which were performed in OR #1. Problems associated with air quality found on initial inspection

were corrected. Cleaning of the Surgical Suite - walls, ceiling, light fixtures, floors, shelving and some equipment was done between May 9th and May 13th, 2002. Air quality was re-tested, and all the ORs except #8 were reopened by May 15th, 2002. Despite the cleaning, heart valves excised on May 23rd and 24th, 2002 also tested positive for *Aspergillus*. As a result ORs #1, 14 and 15 were again closed and cleaned between May 28th and June 3rd.

BRIEF LITERATURE REVIEW

Aspergillus is a mould capable of causing several manifestations of disease both in healthy humans and in immunocompromised patients[1]. The most common pathogenic species of *Aspergillus* includes *Aspergillus fumigatus*, *A. flavus*, *A. terreus*, and *A. niger*. Other species which have rarely caused disease include *A. amstelodami*, *A. avenaceus*, *A. caesiellus*, *A. candidus*, *A. carneus*, *A. chevalieri*, *A. clavatus*, *A. glaucus*, *A. granulosus*, *A. nidulans*, *A. oryzae*, *A. quadrilineatus*, *A. restrictus*, *A. sydowi*, *A. ustus*, *A. versicolor*, *A. wentii*, *A. (Neosartorya) fisheri* and others[1].

Aspergillus is one of the most ubiquitous fungi known in nature. It is found in the soil, in the atmosphere and in/on vegetation[3]. Reservoirs of *Aspergillus* in hospitals can include unfiltered air, ventilation systems, contaminated dust dislodged during construction, carpeting, food and ornamental plants[5]. The impact of nosocomial *Aspergillus* infection is very significant. Case fatality rates for immunocompromised patients can be as high as 100%[3].

Aspergillosis refers to either tissue invasive disease or allergic response caused by *Aspergillus*. Aspergillosis may manifest in a variety of human organ systems. The lung is the most common site as *Asgpergillus* is usually inhaled[1]. Invasive Pulmonary Aspergillosis (IPA) presents in acute and chronic forms. Very immunocompromised individuals, such as allogeneic bone marrow transplant recipients, may have few symptoms initially, but the progression rate is fast (acute IPA) and fatal if untreated. Chronic IPA presents with more indolent respiratory and systemic symptoms. Other sites of Aspergillosis include skin or soft tissue (burn or surgical wound infections), prosthetic valves (endocarditis), eyes, ears, nasal or paranasal sinuses, and brain[1]. Aspergillosis symptoms are often insidious and missed without a high level of diagnostic suspicion. [1,2]

EPIDEMIOLOGICAL INVESTIGATION

Methods

The epidemiological investigation of the hospital's ORs and Microbiology Laboratory focused on the following areas:

1. Inspection
2. Air quality testing
3. Environmental sampling
4. Comparison of environmental and clinical samples

1. Inspection: Initial inspection of the ORs' ventilation system was done by the hospital's Engineering and Maintenance staff on May 7th, 2002. The floor plan for the ORs and microbiology laboratory as well as ventilation system blueprints were obtained by the Field Epidemiologist. The Field Epidemiologist inspected these rooms on May 23rd, 2002, accompanied by an Engineering and Maintenance staff member. Subsequent inspection tours were also made on May 24th and 27th, 2002.

2. Air Quality Testing: The ventilation system supplying the ORs and the microbiology laboratory was tested for particulates. Air pressures were measured, and smoke tests were conducted to observe air flow patterns.

On May 8th, 2002 the Atlantic Indoor Air Audit Company was contracted to test the air quality in all ORs. Specifically, there was need to know if the ORs met the following conditions: particle count <1000/cubic foot at 0.5 micron size, air exchange rate greater than 25 per hour; positive pressure between 2.5 PA and 8.0 PA and HEPA filter supply air. The company conducted air quality tests on May 9th and again after cleaning. Subsequently, after the ORs were again closed and cleaned, the company retested a third time on May 28th and 29th, 2002 respectively.

After the second cluster of valve specimens were identified on May 27th, 2002 it was thought that the valve specimens may have been contaminated elsewhere such as the

Microbiology Laboratory or from the sterile specimen containers rather than in the ORs. Therefore, air quality testing was done in the Microbiology Laboratory on May 29th, 2002. Special attention was directed to the front of the biosafety cabinet, where valve specimens were processed for fungal culture.

3 Environmental Sampling: Approximately 400 samples within the ORs, Microbiology Laboratory and ventilation system were taken to identify *Aspergillus* and other moulds in the environment. Specimens were obtained through air sampling, settle plates, swabs, contact plates, and pressing instruments directly onto agar media.

The Research Productivity Council (RPC) was contracted to obtain and test the air samples. Air samples were taken by a machine, which pumped about 160 L of air into an agar strip for four minutes. The agar strip was incubated for at least 7 days. Between May 7th and May 9th, 2002, a total of 31 air samples were taken from various places within the ORs and other rooms in the Surgical Suite and ventilation system. After ORs were cleaned and reopened between May 14th and May 24th, 2002, air samples were taken again. After expert consultation, larger volumes of air were sampled to improve the yield i.e. instead of a single four minute air sample, three 8 minute air samples were taken at a single site, for a total of 960 liters of air. This revised methodology was used to collect samples in the ORs and Microbiology Laboratory after May 27th, 2002.

Settle plates are agar plates which were left open for several hours and then incubated. The objective was to let fungal spores in the air settle onto these agar plates. Settle plates were placed inside the Microbiology Laboratory and its biosafety cabinet. They were incubated in the hospital's Microbiology Laboratory.

Sterile swabs were used and later inoculated on agar plates for incubation. Swabs were tested by either RPC or the Microbiology Laboratory. They were taken from places within the ventilation system, such as air supply ducts, condenser fan, interstitial and ceiling spaces, or from surfaces and equipment, such as cooling fans from anesthetic or perfusion machines, blanket warmers, drawers of the anesthetic cart, display monitors,

and other areas within the OR wing e.g. storage shelves, locker room shelves, and carpets at OR entrance. On May 21st and 28th, 2002, all equipment in ORs #14 and 15 were swabbed twice: once before and then after the cleaning.

Contact agar plates were used to collect environmental samples from flat surfaces. This is a standard procedure. Contact agar plates are made of a nutrient gel-like substance; the agar surface protrudes over the container rim to touch the flat surface to be sampled. They were not readily available in the hospital and swabs were used for the initial sampling of flat surfaces before May 24th, 2002. After that date contact agar plates were used to collect samples from light domes above the OR tables, OR tables and other tables.

Sterile forceps used in the Microbiology Laboratory to prepare the heart valves for culture were tested by digging them into a normal nutrient agar plate then incubating them. A number of sterile containers from SPD that were used to transport excised valve specimens were also cultured.

4. Comparison of environmental and clinical samples: *Aspergillus* isolates grown from clinical (heart valve) and environmental samples were sent to the National Mycology Reference Laboratory in Edmonton, Alberta for species identification and DNA fingerprinting using the Restriction Fragment Length Polymorphism (RFLP) method.

Observations and Results

1. Inspection: Saint John Regional Hospital has 13 ORs. ORs 1-11, 14, and 15 are located in one area on the first floor. OR #12, the labour and delivery room for obstetrics, is located on the 3rd floor. OR #14 and #15 are used exclusively for cardiac operations. ORs are usually located in pairs with a scrub room in between. In the Surgical Suite there are also storage rooms for equipment, linen supplies, and instrument decontamination rooms. The perfusion room is located across from OR #14.

The air in the hospital is supplied by 32 air-handling units, which supply air from outside the hospital. Air intake openings are located on the roof of the hospital (fifth floor), covered by metal screens. All ORs are supplied by two separate air-handling units, S25 and S27. S25 supplies air to ORs #1-5, 12, 14, and the former burn unit on the 3rd floor. S27 supplies air to ORs #6-11, 15, central core of the OR area, medical intensive care unit (MICU), and the day surgery area. The two air-handling units also supply air to the recovery room and the rest of the OR wing including the hallways.

These air-handling units are huge metal ducts about ten feet square. There are several doors on one side to allow maintenance staff to enter to check the interior of the ducts. Outside air is filtered four times before it enters the OR theatres, the last time is through the HEPA filters. The pad filter removes 35% of 2.5 u particles in the air. The next two layers are bag filters, which are expected to remove up to 95% of 2.5 u particles. There are cooling and heating coils and humidifiers in between these filters. The air is HEPA filtered immediately before entering the ORs. The components of the air-handling units are routinely inspected. HEPA filters are certified annually, at which time their efficacy is measured.

The air in OR #14 and 15 is 50% recycled while all other ORs have a 100% fresh air supply. Fifty percent of the return air from OR #14 and #15 is mixed with the fresh air from air-handling units before it enters an air cooler unit and is subsequently HEPA filtered before re-entering these ORs. Two laminar air diffusers are located on the OR ceiling directly above the OR table; they pump a column of air directly onto the OR table to prevent any dust or contaminant from settling. These square laminar air diffusers are surrounded by linear air diffusers, which pump a curtain of air around the OR table from the ceiling to the floor. This air curtain prevents dust from entering the vicinity of the OR table during surgery. Inspection of OR #14 after hours revealed that the door was left open. This created negative air pressure, pulling non-HEPA filtered air from the hallways and adjacent room into the OR.

Parking lot construction with heavy sand blasting started in April 15, 2002 in an adjacent area north of the hospital. Air-handling unit S27 faces north, toward the construction site. The three layers of filters in both air-handling units were functioning well, but there were leaks around the frame of a filter in the main air handling unit at the penthouse. This was at the level of the particulate filters; it was not downstream at the HEPA filter area. This allowed unfiltered air with a high particle count to mix with the filtered air, contaminating the air supply to the ORs in the pre-HEPA filter duct area. Leaks were also found in the seal of the duct doors, further contributing to the contamination. A thin layer of lint was found in both the return air duct from OR #14 and in the laminar air diffuser in OR #12. Suboptimal water drainage in the air cooler unit led to pooling of the water inside the unit. HEPA filter in OR #6 was not functioning well and the seal around the HEPA filter was twisted. There was a hole in the air damper in OR #12, which allowed outside air to be sucked in without being HEPA filtered.

OR equipment, such as the anesthetic cart and perfusion machine, were not cleaned during routine housekeeping. As a result dust tends to accumulate on the interior and the exterior surfaces. Some machine cleaning is done during regular warranty checks. These specialized machines should be cleaned by individuals who know how to clean them without damaging the equipment. Some of the machines have an interior fan, which aerosolizes the dust when the machine is turned on. Other activities within the ORs, such as movement of individuals, generate air currents which can also mobilize the dust. Visible mould was found on the wall of the cleaning room adjacent to OR #8. Further investigation showed that the mould had spread to the wall of OR #8. Visible mould was also found in the patient holding area and the scrub room between OR #14 and #15.

The Microbiology Laboratory consists of several rooms located on the second floor of the hospital. Its air supply is from the S48 air-handling units. The intakes for S48 also face north to the parking lot where construction was started in April. The laboratory has four biosafety cabinets; valve specimens were processed in the largest biosafety cabinet located on the main room. A shelf beside the cabinet stores equipment, such as forceps and scalpel blades, for use in processing the valve specimens for fungal culture. A vent

above the shelf blows air directly onto the sterile utensils on the shelf. The forceps were purchased in non-sterile packages and placed into capped glass tubes then sterilized in an autoclave. Each metal cap has three small venting holes which provide a possible route of contamination.

2. Air Quality Testing: Negative air pressure (< 0 Pa) was measured in ORs #5, 10, 14 and 15 following the air duct cleaning of OR #14 and #15 on May 8th and 9th. This cleaning required adjustments to balance the damper, thereby possibly impacting the pressure readings. Air pressure in OR #14 was positive, but when the main door was left open it was evident that the hallway air was entering the OR over the top of the open door. A smoke test showed that the air curtain in OR #14 drew air in from other parts of the OR to flow over the OR table. High particle (> 1000/cu.ft) counts were found in ORs #5, 10, 14, and 15. In OR #14, the particle count was especially high around the medical gas column extruding from the ceiling.

A particle count, about 28,000/cu.ft, was detected in the air exiting from the vent located in front of the biosafety cabinet in the Microbiology Laboratory where the valve specimens were processed for fungal culture. This air was blowing directly onto the sterile utensils on the shelf. The air supply in the Microbiology Laboratory itself is not HEPA filtered air but there is a HEPA filter in the biosafety cabinet in which the specimens are processed. Smoke testing confirmed that the airflow within any biosafety cabinet depended on operator technique. Hands or instruments entering the cabinet horizontally maintained the integrity of the air curtain, but diagonal entry disrupted the air curtain at the hood face.

3. Environmental Sampling: Environmental samples from the ORs and ventilation system grew a variety of fungi and moulds e.g., *Aspergillus, Penicillium,* Yeast, *Cladosporium sphaerospermum, Acremonium species, Trichoderma viride, Stachybotrys chartarum* and some non-sporulating colonies. The most common organisms detected were *Aspergillus, Trichoderma viride, Penicillium* and yeast (Table 1). Table 2 lists the areas where *Aspergillus* was isolated.

Air samples and swabs taken on May 24th, 2002 in all ORs, except #15, tested negative. These samples were collected after the ORs were cleaned and re-opened. Results of the cultures taken from the ORs on May 27th are shown in Table 2. Results of the larger volume air samples taken from May 27th and May 28th, 2002 were sent to RPC for analysis. These samples were from the ORs, the Microbiology Laboratory and from SPD. No *Aspergillus* species were recovered from these samples. Air samples taken in OR #15 on May 28th, 2002 showed no growth of *Aspergillus*.

Eight out of 10 agar plates inoculated with sterile forceps were positive. Four were identified as *Aspergillus* species; one of these four was *A. ustus*. The cultures of all other sterile utensils were negative, as were the settle plates placed in the biosafety cabinet. Results from the air samples taken from the biological safety cabinet and the specimen containers were negative for *Aspergillus* species. These results indicate a possible link between the forceps and the observed contamination of the excised heart valves.

4. Comparison of environmental and clinical samples: *Aspergillus* isolates from the valve specimens in September and November of 2001 were not available for species identification. Of the four isolates from the valve specimens in April 2002, three were *A. ustus* and one was *A. sydowi*. One also grew *Penicillium* species. One of the two *Aspergillus* isolates from the valve specimens in May 2002 was *A. ustus* and the other was *A. fumigatus*.

DISCUSSION

Contaminated OR Air

Structural defects in the ventilation system in the two ORs dedicated to heart surgery combined with construction dust laden with fungal spores[8,11] may explain the positive excised heart valve specimens. *Aspergillus* was isolated within ORs #14 and 15, including the surface of the OR table. More fungal spores may have been aerosolized when equipment within the OR was activated, as *Aspergillus* was isolated from swabs within the ORs. The spore count from the air sample in OR #14 was 100 times higher than the recommended level of 0.1 CFU/ m^3 [4]. The practice of leaving the specimen containers open prior to the valve specimens being placed in them may have resulted in fungal spores settling into the specimen containers and contaminating the tissue.

Contamination within the Microbiology Laboratory

Another possibility is that the heart valves were contaminated with *Aspergillus* in the Microbiology Laboratory. The environmental investigation revealed possible sources of fungal contamination. The forceps used to prepare the heart valves were sterilized, but small venting holes on the sides of the covers of the glass storage tubes may have permitted entry of fungal spores blown from the vent above the biosafety cabinet. The finding that eight of ten agar plates inoculated with sterile forceps were positive suggests that the valves became contaminated when they were handled by the contaminated forceps.

The evidence is strong that there were outstanding defects in the ventilation system and maintenance within ORs #14 and 15 resulting in fungal and mould contamination. This could account for the sporadic *Aspergillus* isolates in September and November 2001. The cluster of contaminated excised heart valves in April and May of 2002 may have been due to the parking lot construction in April, as the literature supports contamination of hospital air from construction[6-8,10,11]. Most outbreaks of nosocomial Aspergillosis have been traced to disturbances of dust and dirt due to construction within or around the hospital [2,9,12-19].

The species identified from environmental testing in the OR at the Saint John Regional Hospital are not the most pathogenic. However, the second *Aspergillus* cluster in May is not well explained by air contamination in the ORs. Structural defects had been repaired, and repeat air pressure and particle counts were within acceptable limits post-cleaning. The lack of equipment cleaning may have generated some fungal spores, but this was presumably mitigated by specimen containers which were kept closed until the excised heart valves were placed in them. As the particulate burden lessened, contamination of the valves within the minutes required to excise them became unlikely. Microbiology Laboratory contamination, through contaminated forceps, may better explain these results.

Patient Follow Up

A follow up of patients who were possibly at risk for *Aspergillus* exposure was initiated. Patients included in the follow up had open heart surgery in ORs #14 or 15 between April 15th and May 27th, 2002. April 15th was chosen because it was the day heavy blasting and construction began just north of the hospital. May 27th was chosen because it was the last day ORs 14 and 15 were re-opened after the second cluster of positive valve specimens was identified and terminal cleaning initiated. Seventy patients who met these criteria were identified.

The first phase of the follow up was completed by the Health Record Department. Demographic information, as well as information concerning the recent surgical procedure, was obtained from the patients' chart. Following the chart review, the Atlantic Health Sciences Corporation Patient Representation phoned each patient to determine if they had developed any symptoms possibly related to *Aspergillus* exposure. Two infectious disease specialists contacted the patients' family doctors or the patients themselves to see if further evaluation was needed.

Sixty-nine of the 70 patients were contacted. Names of patients who had specific symptoms were forwarded to two Infectious Disease Consultants at SJRH for possible further evaluation. Those who had no symptoms were contacted again six months after

their operation (maximum incubation period for invasive *Aspergillus* infection) in order to make sure that they continue to be symptom free.

The Infectious Disease Specialists reviewed the charts of the patients with symptoms then contacted the patient's Family Doctors, or the patients themselves, to see if further evaluation was necessary. A total of 37 patients were included in this group. Clinic time in Ambulatory Clinic I was set aside for this purpose. No patients had symptoms unexplained by routine post-operative complaints or other well defined medical conditions. Therefore, no specific investigations to rule-out invasive *Aspergillus* disease were necessary. This phase of the follow-up took place between August 2002 and November 2002.

In addition to this follow-up, the two patients who had sporadic, and isolated, positive valve cultures for *Aspergillus* in the 10 months preceding the clustered positive cultures were contacted by one of the Infectious Disease Specialists. Neither had signs of invasive *Aspergillus* disease well beyond the maximum incubation period.

RECOMMENDATIONS

The environmental contamination in the ORs was serendipitously discovered because excised heart valve specimens were being cultured according to protocol. Hospital officials decided to investigate the cause of the contamination. As a result of this investigation, the following recommendations are being made in four areas in order to achieve optimal infection control measures within the hospital to prevent future occurrences. The four areas are:

1. Routine maintenance of hospital ventilation system and air quality testing
2. OR policies, procedures, and environmental cleaning
3. Quality control in the Microbiology Laboratory
4. Coordination and implementation of infection control measures

1. Routine Maintenance of Hospital Ventilation System and Air Quality Testing

Recommendations:

(a) Routine inspection for structural defects or damage should be done quarterly. Any defect or damage found should be dealt with according to a standard protocol developed by the hospital. The protocol should encompass the following issues:

(i) Reporting and recording

- List of individuals who need to be informed
- Mechanism for reporting (phone call, email, memo, incident report)
- Standardized recording of the problem

(ii) Repair process

- Address patient safety and occupational safety
- Follow the protocol for damage repair (e.g. negative air pressure and barriers to prevent dust contamination)
- Coordination of damage repair (e.g. appropriate staff informed to prevent service disturbance)

(iii) Evaluation

- Safety and efficacy of structure after the repair should be verified by air quality testing and/or environmental sampling

- Prevention of further and future damage

(b) Air pressure in the ORs and other parts of the hospital that require specialized pressurization should be checked and documented monthly to compare observed air pressure in these areas with the recommended standard. Any deviation in the pressure should be investigated and the defect corrected immediately and documented.

(c) Particle count in ORs and other parts of the hospital where the specialized air filtration such as HEPA filters are required should be checked and documented monthly to see if the particle count in these areas meets the recommended standard (< 1000/cu.ft). Counts higher than the acceptable level should be investigated and the defect(s) corrected immediately and documented. Routine air sampling is not recommended unless the particle count is higher than the acceptable level. [3, 4]

2. ORs Rules, Procedures, Enforcement and Education

Recommendations:

(a) Enforcements of the following should be implemented:

(i) Food and drinks should be prohibited inside ORs

(ii) Stricter dress codes (e.g. no outside footwear or brief cases in ORs)

(iii) Stricter procedures (e.g. ORs doors must remain closed at all times)

(iv) In service of OR staff on the rules and the reasons for their implementation

(v) Random check at least twice a month to see if rules are followed (both day and night shifts) and address infractions.

(b) Environmental cleaning must be improved:

(i) In service of all house- keepers on cleaning practices

(ii) All cleaning protocols should be reviewed and revised if necessary, e.g.:

- Cleaning between cases
- Cleaning at the end of the day (all flat surfaces included)
- Weekly cleaning (all machines included)
- House cleaning

(iii) Routine surveillance of cleaning practices

(iv) Prompt cleaning or repair of water-damaged surfaces

3. Review Quality Control in Microbiology Laboratories

Recommendations:

(a) Microbiology should review its practices with respect to preparation, storage, use of sterile utensils and media and should comply with industry standards.

(b) The observation of unusual particulate counts within the lab should be corrected.

(c) The placement of the biosafety cabinet and sterilized instruments in relation to air vents should be reviewed.

(d) Equipment certification such as the biosafety cabinet should be reviewed. Certification should be done by a different company from the one which previously certified the cabinets and different from the company providing the current assessment.

4. Coordination and Implementation of Infection Control Measures

Recommendations:

(a) Two working committees should be established and report to the Infection Control Committee of the hospital

(i) OR Environment Committee

- This committee should include representatives from Maintenance and Engineering, Environmental Services, OR staff, Surgery, Anesthesia, Infection Control Coordinator, and the Biomedical Services.
- The committee should review the issues related to the OR environment mentioned above.
- The committee should make detailed recommendations and establish new or revise existing maintenance and cleaning protocols to achieve the safest environment in ORs.

(ii) Microbiology Laboratory Committee

- The committee should include representative from Maintenance and Engineering, Environmental Services, Infection Control Coordinator, Biomedical Services and the Microbiology Laboratory.
- This committee should review the quality control issues related to the laboratory and make recommendations on how to improve the environment within the laboratory.
- The existing Hospital Infection Control Committee should include representatives from the Risk Management, Maintenance and Engineering, Environmental Services, Infection Control Coordinator, OR staff, Biomedical Services and the Microbiology Laboratory.

Table 1

Results of environmental samples taken in OR # 14 and 15

A = *Aspergillus*, P = *Penicillium*, Y = Yeast, C = *Cladosporium sphaerospermum*,

Ac = *Acremonium species*, T = *Trichoderma viride*, S = *Stachybotrys chartarum*

Al = *Alternaria alternata*

** non-sporulating colonies are not included here

Sample Date	Type	Site in OR # 14	Organisms
May 7, 2002	Air	Outside table area OR 14	Ac
May 7, 2002	Air	At table OR 14	T
May 7, 2002	Air	Hall outside OR 14	T
May 9, 2002	Air	OR 14 Ceiling Space	A*
May 9, 2002	Air	OR 14 behind Autoclave	P
May 11, 2002	Swab	Utility room between ORs 14 & 15 supply diffuser over door	T
May 11, 2002	Swab	Utility room between ORs 14 & 15 back of fridege 0264	T
May 11, 2002	Swab	OR 14 back vent Rapid point 200 serial #3198	P, Y
May 11, 2002	Swab	OR 14 Main Overhead Instrument Table	T
May 11, 2002	Swab	OR 14 Med Gas Column Electrical Outlet	A
May 11, 2002	Swab	OR 14 Around Suture boxes on shelf	T
May 11, 2002	Swab	OR 14 OR table	A

* spore count = 100 CFU/m^3 (CFU = colony forming units, m^3 = cubit meter)

Sample Date	Types	Site in OR # 15	Organisms
May 11, 2002	Swab	OR 15 tray table	T
May 11, 2002	Swab	OR 15 small table	T
May 11, 2002	Swab	OR 15 back of Onguard Machine	P
May 11, 2002	Swab	OR 15 Vent Aspect A-1050 Machine	A
May 11, 2002	Swab	OR 15 Vent Datax-Ohmeda Display	A
May 11, 2002	Swab	OR 15 Med Gas Column Back electrical outlets	A
May 11, 2002	Swab	OR 15 OR table	P
May 11, 2002	Swab	OR 15 monitor arm	P
May 11, 2002	Swab	OR 15 2nd shelf on right storage	T
May 11, 2002	Swab	OR 15 steel vented basin	T

Table 2

Details of all isolates of *Aspergillus*

Site	Date of Sample	Type	Place where specimen taken	Organism
OR # 1	May 11, 2002	Swab	Anaesthetist cart Back Vent	**A**
	May 11, 2002	Swab	Back Vent of Luxtec Vision Machine # 0444796	A
OR # 2	May 11, 2002	Swab	Top of Blanket Warmer	A
OR # 3				
OR # 4				
OR # 5	May 11, 2002	Swab	Back Vent Insta Trak14 3000 Display	A
OR # 6	May 11, 2002	Swab	Anaesthetist cart Back Vent Capnomac Ultima Machine Serial # 349908	A
OR # 7	May 11, 2002	Swab	Top shelf middle unit	A, T
	May 11, 2002	Swab	Anaethetist machine top drawer	A
OR # 8				
OR # 9	May 11, 2002	Swab	Stainless Steel table bottom shelf	A, T
	May 11, 2002	Swab	Anaethetist cart top drawer	A
OR # 10	May 11, 2002	Swab	Back Vent Hydravision display	A
OR # 11				

Room 12	May 16, 2002	Swab	169 Induction Room top of shelf left of sink	A, T
OR # 12	May 11, 2002	Swab	Top of Shelf A	A, P
Room 13	May 11, 2002	Swab	Linen and supplies top of locker	A, P
	May 11, 2002	Swab	119 Bottom of Hopper	A
OR # 14	May 9, 2002	Air	Ceiling Space	A, P, T
	May 11, 2002	Swab	OR Table	A, P
	May 11, 2002	Swab	Med Gas Column electrical outlets	A
OR # 15	May 11, 2002	Swab	Vent Aspect A-1050 Machine	A
	May 11, 2002	Swab	Vent Datax-Ohmeda Display	A
	May 11, 2002	Swab	Med Gas column back electrical outlets	A
Perfusion Room	May 11, 2002	Swab	Back of Sequestra 1000 machine	A, T
	May 11, 2002	Swab	Top shelf next to desk opposite of fridge	A
	May 11, 2002	Swab	Top of ice maker-Hall outside perfusion room	A, P, T
Air supply	May 7, 2002	Air	Interstitial Near S2-7	A
	May 7, 2002	Air	Supply Fan S 2-5	A, C, P

	May 7, 2002	Air	Outdoors	A, C, Y, Al
Men's Room	May 11, 2002	Swab	Men's change room above phone	A
	May 11, 2002	Swab	Men's change room above Dr. Sheppard's locker	A
OR # 4	May 14, 2002	Air	Just cleaned (may have been vacuumed)	A
OR #14	May 14, 2002	Swab	Gyproc Wall -Hall to OR 14	A, P
Room 13	May 16, 2002	Air	Hallway Across from Room 13.116	A, P
Room 12.213	May 16, 2002	Swab	Electrical room upper left corner	A
Outside	May 16, 2002	Air	Air sample	A, Y

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